BNL-91167-2010-CP

ENCAPSULATION EFFECTS ON CARBONACEOUS AEROSOL LIGHT ABSORPTION

Arthur Sedlacek, *Brookhaven National Laboratory*
Timothy Onasch, *Aerodyne Research, Inc.*
Paul Davidovits, *Boston College*
Eben Cross, *Boston College*
Claudio Mazzoleni, *Michigan Technological University*

For presentation at
the First Science Team Meeting of
the Atmospheric System Research (ASR) Program,
Bethesda, MD
March 15-19, 2010

Environmental Sciences Department/Atmospheric Sciences Division
Brookhaven National Laboratory
P.O. Box, Upton, NY
www.bnl.gov

ABSTRACT

The contribution of aerosol absorption on direct radiative forcing is still an active area of research, in part, because aerosol extinction is dominated by light scattering and, in part, because the primary absorbing aerosol of interest, soot, exhibits complex aging behavior that alters its optical properties. The consequences of this can be evidenced by the work of Ramanathan and Carmichael (2008) who suggest that incorporating the atmospheric heating due to brown clouds (plumes containing soot byproducts from automobiles, biomass burning, wood-burning kitchen stoves, and coal-fired power plants) will increase black carbon (BC) radiative forcing from the Intergovernmental Panel on Climate Change best estimate of 0.34 Wm-2 (±0.25 Wm-2) (IPCC 2007) to 0.9 Wm-2. This noteworthy degree of uncertainty is due largely to the interdependence of BC optical properties on particle mixing state and aggregate morphology, each of which changes as the particle ages in the atmosphere and becomes encapsulated within a coating of inorganic and/or organic substances. In July 2008, a laboratory-based measurement campaign, led by Boston College and Aerodyne, was initiated to begin addressing this interdependence. To achieve insights into the interdependence of BC optical properties on particle mixing state and aggregate morphology, measurements of both the optical and physical properties of flame-generated soot under nascent, coated, and denuded conditions were conducted. This poster presents data on black carbon (BC) light absorption measured by Photothermal Interferometry (Sedlacek and Lee. 2007). In addition to examining nascent BC--to provide a baseline measurement—encapsulation with varying thicknesses of either dioctyl sebacate (DOS) or sulfuric acid was conducted to glean insights into the interplay between particle mixing state and optical properties. Additionally, some experiments were carried out where BC was coated and then denuded. In the case of DOS-coated soot, a monotonic increase in light absorption to nearly 100% is observed as a function of DOS coating thickness. This observation is consistent with a coating-induced amplification in particle light absorption (Bond et al.. 2006). In contrast, light absorption by sulfuric acid-coated soot displays unexpectedly complex behavior where the degree of amplification appears to be dependent upon the underlying soot core diameter.

This poster will be displayed at ASR Science Team Meeting.